the posterior aorta divides into three large arteries: one of these (*o*) is situated in the median plane, and crossing the branchial cavity in a curved line along the edge of the thin median membrane, supplies the ventral and lateral portions of the mantle, sending branches both forward and backward; the other two main branches (*o′ o″*) diverge as they go backward and supply the caudal fins and adjacent parts of the mantle. The anterior aorta (*ao*) arises from the right anterior corner of the heart, and goes forward to the head, on the right side of the median line, by the side of the œsophagus, giving off from its sides various small branches. Near its origin it is somewhat bulbous.

The first branch, the gastric artery, arising not far from its origin, sends a branch to the renal organs, and running backward over the dorsal side of the heart, ramifies over both lobes of the stomach. During its passage through the substance of the liver, and along the groove on its dorsal side, the aorta gives off several branches which supply that organ with blood, while one artery, of considerable size, emerges from the posterio-dorsal side of the liver and supplies the muscles of the neck; others go out from the anterior part of the liver, laterally and ventrally, to various parts of the head. Ten large branches go to the arms, one running through the center of each to the tip, sending off numerous lateral branches to the suckers and other parts. Other branches supply the various organs of the head. A small artery (fig. 2, *go*) arises from the anterior side of the heart, and turning backward, supplies the spermary (*t*). The large efferent vessels (*branchio-cardiac*) from the gills (*bo*) enter the anterio-lateral corners of the heart, their dilated basal portions serving as auricles.

The branchial auricles (*au*), situated just behind the bases of the gills, are nearly globular, with a small, rounded, whitish elevation on the free posterior end; dorsally they receive the blood from the saccular divisions of the anterior and posterior venæ-cavæ (*vc, vc′*) and from the veins (*v, vc′*) coming from the lateral portions of the mantle, behind the gills; and they give off the large afferent vessels (*bv*) which go to and run along the dorsal side of the gills.

The anterior vena-cava (*vc*) receives the venous blood from a large cephalic venous sinus, which surrounds the pharynx, at the bases of the arms,* and is connected with another large sinus situated at the

* The greater part of the venous system can be easily injected by inserting a canula into this sinus, through the fold of the buccal membranes between the bases of the arms and the jaws, or between the outer and inner buccal membranes. It can also be easily injected through the vena-cava in the lower side of the head.

back of each eye-orbit. This cephalic sinus receives the blood from a large vein in the median line and near the inner surface of each arm. Numerous small veins from the head and eyes also enter this and the ophthalmic sinuses; others, entering the anterior vena-cava, from each side, along its course, come from the muscles of the head, neck and siphon, from the ink-sac, anterior part of the liver, etc. Two veins of considerable size, which become sacculated posteriorly, arise from the intestine and ink-sac and run back to the sacculated divisions of the vena-cava. A small vein also extends along the dorsal side of the efferent sperm-duct (*p*). Two large pallial veins, uniting together close to the branchial auricles, on each side, come from the sides of the mantle (*v*, *vc'*); one of these (*vc'*) runs from the anterior part backward, and receives a branch (fig. 1) from the gill; the other (*v*), from the middle and posterior parts forward. The posterior venæ-cavæ (*vc''*) arise mostly in the caudal fins and posterio lateral portions of the mantle; each one receives two large branches, one anterior and the other posterior, just at the point where it leaves the inner surface of the mantle. From this point they run forward parallel with the two posterior arteries, and converge to the region of the heart, where they join the great sacculated venous vessels (*r*); along a considerable portion of their course they expand and become large, elongated, fusiform organs (*r'*), probably renal in function, but much firmer, more definite in form, and finer in structure than the more anterior renal organs.

The gills (*g*) are long, triquetral, acute, in section they are nearly triangular, with the free ventral sides convex, and the dorsal side flat or concave, except along the middle, where a thin median membrane (*g*) arises from the central stem and unites the gill to the inner surface of the mantle. The gills are composed of large numbers of thin, transverse branchial laminæ, which extend outward symmetrically on each side from the large median blood vessels (*bo*, *bv*), each lamina having a long-ovate or crescent-shaped outline. A somewhat firm central axis or column gives support to the laminæ and the large blood vessels. The great afferent vessel (fig. 1, *bv*) starts from the branchial auricle (*au*) and runs along the median-dorsal side of the gill, on the inner edge of the axial column; a parallel vein (fig. 1), near the dorsal edge of the column, runs back and joins the lateral pallial vein (*vc'*). Each branchial leaf receives from the afferent vessel (*bv*), a branch which runs along the dorsal edge, giving off at regular intervals small, transverse, parallel branchlets, which in turn give off minute capillary vessels along their sides, and fade out near

the ventral border of the laminæ. Parallel with these arise small, capillary, efferent vessels, which join larger transverse vessels, between and parallel with the afferent ones; these in turn join the larger efferent vessel that runs along the ventral edges of the laminæ, and these marginal vessels pour their contents into the large branchio-cardiac vessel (*bo*) which runs along the middle of the gill, on the ventral side, and carries the purified blood to the heart.

The buccal membranes, the pharynx, with its horny jaws, the odontophore, armed with seven rows of recurved teeth on the radula, and the thin, chitinous, lining membrane, which has numerous sharp, scattered, recurved teeth, both on the palate and in the throat, have already been described (pp. 311, 312). The œsophagus is a long, narrow, but dilatable tube, having two oblong salivary glands attached to it, within the bilobed anterior end of the liver (*l*); it then runs backward in a groove along the dorsal side of the liver, to a point beyond its middle, where it passes obliquely through the liver, accompanied by the aorta (*ao*), and dorsally enters the stomach (*S*). The stomach consists of three parts, which are often sufficiently distinct externally, when the stomach is empty, or nearly so, but when it is greatly distended with food (as often happens), the apparent divisions almost disappear and the whole becomes one great, long-pyriform sac. The first division (*S*) or 'true stomach,' is plicated internally and has thickened glandular walls. It is supplied with blood by a conspicuously ramified vessel, the gastric artery (*so*). This lobe of the stomach is sometimes contracted into a firm glandular mass, strongly constricted where it joins the more saccular second stomach; but I have seen specimens greatly distended with food in which it was scarcely or not at all distinguishable as a lobe, and seemed as thin and saccular as the other parts. The remainder of the stomach (*S'*) usually has the form of a long, more or less swollen, ovate sac, tapering backward to a somewhat acute posterior end, which reaches back nearly to the end of the body; anteriorly its most swollen portion is about opposite the junction with the first stomach, and just behind the heart; from this swollen portion it narrows rapidly, but extends forward along the posterior part of the liver, above and in advance of the heart, where it gives off the intestine. The more swollen anterior portion (*k*), of this sac, the second stomach, has a glandular lining and is distinctly radially plicated, and is, therefore, clearly anatomically distinguishable from the thin and non-plicated posterior portion, or cœcal lobe, (*S'*) which seems to serve mainly for the temporary storage of large quantities of food.

The intestine (*h*) is a rather wide and thin tube, of moderate length; the anal orifice is provided with two slender, clavate papillæ. The ink-sac (*i*) is large, long-pyriform, with a long tapering duct (*i'*) terminating just within the anal orifice. The liver (*l*) is a long, rather narrow, somewhat fusiform organ, slightly bilobed anteriorly and pointed posteriorly; along about two thirds of its length, from the anterior end, there is a deep dorsal groove, in which the œsophagus and aorta are situated, before they pass through its substance; the posterior end is simple and pointed.

In the appearance and structure of the internal reproductive organs the sexes differ greatly. In the female (pl. XL, figs. 3, 3*a*; pl. XLI, fig. 1), the single large oviduct (*od*, *od'*), situated on the left side, passes over the dorsal side of the base of the gill and terminates in a large ear-shaped external orifice (*op*), nearly surrounded by a broad membranous flap. The portion of the oviduct behind the base of the gill is enveloped by a large, swollen, bilobed, nidamental gland (*x'*), which is abundantly supplied with blood-vessels, and internally is composed of a large number of thin, close, parallel lamellæ. Two very large, oblong, accessory nidamental glands (*xx*) lie, side by side, loosely attached, nearly in the middle of the ventral side, covering and concealing the heart and most of the renal organs; each of these has a groove along the ventral side and a slit in the anterior end; internally they are composed of great numbers of thin lamellæ. In front of, and partially above the anterior ends of these, and attached to the intestine and ink-sac, there is another pair of accessory glands (*x*), roundish in form, with a large ventral opening, and having, in fresh specimens, a curiously mottled color, consisting of irregular red and dark brown blotches, on a pale ground. Their internal structure is made up of fine follicles.

The ovary (*ov*) is large and occupies a large portion of the cavity of the body posteriorly, running back into the posterior cavity of the pen, and in the breeding season, extending forward nearly to the heart. In the breeding season, the thin convoluted portion of the oviduct (*ov'*) is found distended with great numbers of eggs. At the same time the large glands (*x'*), around the oviduct, and the accessory nidamental glands (*x*, *xx*), destined to furnish the materials for the formation of the egg-capsules, and for their attachment, are very turgid and much larger than at other times.

The male (Pl. XL, figs. 1, 2) has no organs corresponding in position to the two pairs of accessory nidamental glands of the female, but the single efferent spermatic duct or 'penis' (*p*) occupies the same

position, on the left side, as the terminal part of the oviduct of the female. It is, however, a much more slender tube, extending farther forward beyond the base of the gill, and its orifice is small and simply bilabiate. It extends backward, over the dorsal side of the base of the gill, to a bilobed, long-pyriform organ, consisting of a spermatophore-sac (*ss*) and a complicated system of glands and ducts (*pr*,, *vd*), united closely together and enclosed in a special sheath; in these the spermatophores are formed. These organs consist of the following parts:

1. The vas-deferens (*vd*), which starts posteriorly from a small orifice (not figured) in the thin sheath of peritoneal membrane (*pt*) investing the testicle (*t*); it passes forward along the side of the spermatophore-sac, to which it is closely adherent, and throughout most of its length it is thrown into numerous close, short, transverse, flattened folds; anteriorly it joins the vesiculæ-seminales.

2. The vesiculæ-seminales (fig. 2, *pr*, in part) consist of three large curved vesicles, closely coiled together, and having thickened, glandular walls; the first two are short and broad, the third is elongated; from the latter goes a short duct, which unites with the duct from the prostate gland to form the spermatic duct.

3. The prostate gland (*pr*, in part) is broad-ovate and consists of two rounded lobes, one large and the other small, which are closely united to and enclosed between the vesiculæ-seminales.

4. The spermatic duct, formed by the union of the ducts from the vesiculæ-seminales and prostate glands, is a nearly straight tube; it passes backward between the prostate glands and spermatophore-sac, close alongside of the vas-deferens (*vd*), to which it is closely bound down; it enters the spermatophore-sac (*ss*) near its posterior end, at an acute angle. Even at its origin it contains spermatophores.

5. The spermatophore-sac (*ss*) is a long, capacious, pyriform or somewhat fusiform, thin-walled sac, pointed at its posterior end; its anterior end is directly continuous with the long efferent duct (*p*), which is often rather wide at its origin, but tapers to a narrow anterior end. The terminal orifice is slightly bilabiate.

These organs receive blood through a special artery (fig. 2, *po*) which arises from the posterior aorta just back of the heart. After reaching the genital organs it divides into several branches: one goes forward along the side of the efferent duct; one to the prostate glands and vesiculæ-seminales; one to the vas-deferens and adjacent parts.

Specimens taken in May, in the breeding season, have the efferent

duct and the spermatophore-sac crowded with the spermatophores. In the spermatophore-sac, which is then much distended by them, they lie closely packed in a longitudinal position, with their larger ends pointing somewhat outward toward the surface, and can be plainly seen through the transparent walls of the sac.

The spermatophores are slender, club-shaped, with the larger end rounded, tapering gradually to the smaller end, which is usually a little expanded at the tip and has a very small filament. They vary (in alcohol) from 8 to 10^{mm} in length and from $\cdot 4$ to $\cdot 5^{mm}$ in the greatest diameter. They contain a coiled rope of spermatozoa in the larger end, and a complicated apparatus for automatically ejecting this rope, in the smaller portion.

The 'testicle,' or spermary (*t*), is a compact, pale yellow, long, flattened organ, extending from the stomach (*S*) nearly to the end of the pen, in the posterior concavity of which it lies; a band of fibrous tissue, continuous with its sheath, extends from its posterior end into the hollow tip of the pen, to which it is attached. An arterial vessel, the spermatic artery (Pl. XL, fig. 2, *go*), which arises directly from the anterior edge of the heart, runs along the median dorsal line of the spermary and sends off numerous branches to the right and left (fig. 2, *t*). This artery is accompanied by a spermatic vein which is closely united to it.

Loligo brevis Blainville.

Loligo brevis Blainv., Journ. de Phys., March, 1823 (t. D'Orb.); Dict. des. Sci. nat., vol. xxvii, p. 145, 1823.

D'Orbigny, Céphal. Acétab, p. 314, *Loligo*, pl. 13, figs. 4–6 (copied from Lesueur), pl. 15, figs. 1–3 (orig.); pl. 24, figs. 14–19 (orig.)

Tryon, Man. Conch., i, p. 142, pl. 52, figs. 143, 144 (after D'Orbigny.)

Loligo brevipinna Lesueur, Journ. Acad. Nat. Sci. Philad., vol. iii, p. 282, plate 10, figs. 1–3, 1824.

Tryon, Man. Conch., i, p. 142, pl. 51, figs. 128–130 (after Lesueur.)

A small, short-bodied species, with short, rounded caudal fins, very short upper arms, and large chromatophoric spots. Body short, thick, well-rounded, rather blunt posteriorly. Anterior edge of mantle with a well-developed median dorsal lobe, and well-marked lateral angles. Fins broad transversely, short, less than half the length of the mantle; outer edges well-rounded; posterior end very obtuse. Arms all short, the two upper pairs much shorter than the two lower, the dorsal pair very short, considerably shorter than the upper lateral ones; ventral and lower-lateral arms nearly equal in length. The dorsal arms are strongly compressed, with a well-marked thin dorsal keel; those of the second pair squarish at base,

without a keel; those of the third pair are strongly compressed, bent outward at base, and furnished with a high median keel, starting from the base, but highest in the middle; ventral arms triangular at base, with a wide membrane on the upper angle, which expands at the base, and connects them with the third pair; a narrower membrane runs along the ventral margins. Tentacular arms rather stout at base; compressed farther out, in extension about as long as the body; club well-developed, about twice as broad as the rest of the arm; its dorsal keel is thin, elevated, oblique, commencing at about the middle of the club and extending to the tip. The larger tentacular suckers are very regularly arranged in four rows, of 8 to 10 each, the lateral ones being not very much smaller than the median ones. The distal part of the club is covered with four regular rows of small suckers, and there is a terminal group of smaller, smooth-rimmed ones. The larger median suckers are broad cup-shaped, rather larger than the largest suckers of the lateral arms; their horny rims are armed with regular, sharp, incurved teeth, smaller on the inner side of the sucker, but there are few or no small teeth alternating with the larger ones. The lateral suckers are relatively large, deep cup-shaped, oblique, with very sharp incurved teeth on the outer margin. The membranous borders of the large suckers are covered with minute, sharp, chitinous scales.

The suckers of the short arms are very deep and oblique, cup-shaped; their rims are much the highest on the outer and distal side, where the edge is divided into several broad, bluntly rounded denticles, separated by narrow intervals.

The pen is short, with a broad-lanceolate blade; the narrow part of the shaft is short; a thin border, widening backward to the blade, commences about half way between the tip and the proper blade; the latter is broad and thin, marked with divergent lines; posterior end obtuse.

The color is peculiar. It consists, in alcoholic specimens, of dark purplish chromatophores, pretty uniformly and regularly scattered everywhere on the body, on a pale ground-color; when expanded the chromatophores are large and rounded; above the eyes they are so closely crowded as to form dark blotches; they also cover the outer surfaces of all the arms; under side of caudal fin white.

In alcohol, a medium-sized specimen measures, from tip of tail to base of dorsal arms, 80^{mm}; total length of mantle 71^{mm}; breadth of body, 22^{mm}; breadth of caudal fin, 52^{mm}; length of fin, 39^{mm}; length of dorsal arms, from base, 17^{mm}; of second pair, 23^{mm}; of 3d pair, 31^{mm}; of ventral arms, 31^{mm}; of tentacular arms, 46^{mm}; of club, 22^{mm}.

One specimen (♀) from Charlotte Harbor, Fla., is much larger than usual. It has the mantle 130^{mm} long; diameter of body, 36^{mm}; length of dorsal arms, 45^{mm}; of 2d pair, 55^{mm}; of 3d pair, 65^{mm}; of tentacular arms, 145^{mm}.

This species appears to have a wide distribution along the warmer parts of the American coast. The original specimen, described by Blainville, was from Brazil. D'Orbigny records it from Rio Janeiro. It extends northward to Delaware Bay. I have also seen specimens from Florida and from Mobile Bay, Alabama.

Loligo brevis.—Specimens examined.

No.	Locality.	Collected by	When rec'd.	Rec'd from.	Specimens. No.	Sex.
	Hampton, Va.	Dr. Marmion	1880	U. S. Nat. Mus.	1	♀
	St. John's River, Fla.	S. F. Baird	----	" "	1	♀
41	Charlotte Harbor, Fla.	----------	----	Mus. Comp. Zoöl.	2	♀
641	Mobile, Alabama	Dr. Nott	Jan. 1857	" " "	3	♀
	Texas	Wurdemann	----	" " "	6	

Sepioteuthis sepioidea D'Orb.

Loligo sepioidea Blainville, Dict. Sci. Nat., xxvii, p. 146, 1823.

Sepioteuthis sepioidea D'Orbigny, Céph. Acétab., p. 298, *Sepioteuthes*, pl. 7, figs. 6–11; Hist. L'Ile de Cuba, Moll., p. 34, 1853.

Gray, Catal. Moll. Brit. Mus., i, p. 81, 1849.

Tryon, Man. Conch., i., p. 153, pl. 63, fig. 216. (Description copied from Gray; figure from D'Orbigny).

Although this species has not been recorded from north of Cape Hatteras, it is introduced here, because its common occurrence at the Bermudas and Florida renders it probable that it will, at times, be found farther north.

It differs from the related species in having a pen without any marginal thickenings; the lateral fins commence at a short distance behind the mantle edge (5^{mm} to 8^{mm}) and, taken together, have a long-rhomboidal figure, broadest nearly in the middle, and obtuse posteriorly; the sessile arms have wide marginal membranes; the dorsal arms are compressed, and much shorter than the others; the lower lateral arms are much the largest, with a strong dorsal keel; the suckers on the sessile arms are so crowded as to appear almost as if in four rows.

The tentacular club bears four regular rows of large suckers, the median ones but little larger than the lateral; small distal suckers in four regular rows, the lower ones largest. The larger suckers have regular, rather long and slender teeth, those on the inner edge

smaller. The suckers of the sessile arms are deep, very oblique, with a high rim, which has on the outer margin a number of regular, long, slender teeth, rather close together.

The whole surface is rather regularly and closely spotted with purple chromatophores.

The eggs are large, 5^{mm} to 8^{mm} in diameter, and comparatively few in number. In one female (No. 379) taken in July, the oviduct was distended with the eggs, which have a reticulated surface before reaching the glandular portion. This female had spermatophores attached to and around an elevated area on the inner ventral surface of the inner buccal membrane.

The oviduct is large and its external orifice has a wide ear-shaped border, more complicated than in *Loligo*. The nidamental glands correspond nearly with those of *Loligo*, but are relatively larger. In some of the males, taken in July, the spermatophore-sac and a saccular dilation near the orifice of the efferent duct, were filled with spermatophores, much like those of *Loligo*.

The male has the left ventral arm hectocotylized much as in *Loligo*. The stems of the suckers, for a considerable distance, toward the tip of the arm, become long, stout, conical, and many of them, in both rows, lack the rudimentary suckers.

This species is widely distributed along the tropical coasts of America, and throughout the West Indies. Martinique (Blainville); Honduras (Gray).

Specimens examined.

No.	Locality.	Collector.	Date.	Rec'd from	Specimens. No. Sex.
	Bermudas	G. Brown Goode	1878	G. B. G.	1
44	Key West, Fla.	Dr. J. B. Holder	1861	Mus. C. Zool.	2 l. ♂, br.
379	Fort Jefferson, Fla.	D. P. Woodbury	July, 1859	" "	1 l. ♀, br.
62	Cuba	Professor Poey	----	" "	2 ♀, juv.

The genus *Sepioteuthis* is closely related to *Loligo* in all external characters, but its fins extend along nearly the whole length of the mantle, and the body is stouter, more ovate, and less pointed behind than in *Loligo*, so that the form is somewhat like that of *Sepia*. The pen is thin and lanceolate, nearly as in *Loligo*, but in many species the blade is thickened toward the margins. The internal anatomy is, however, very different from *Loligo*, in several respects. The ovary is short and thick, and confined more to the posterior portion of the body. The eggs are comparatively few and very large, being 5^{mm} to 8^{mm} in diameter, in our species.

Family SEPIOLIDÆ Keff.

Kefferstein, in Bronn, Thier-Reich, iii, p. 1443, 1866.
Gill, Arrangement of Families of Mollusca, p. 2, 1871.
Tryon, Man. Conch., i, pp. 102, 155, 1879.

Body short, thick, bluntly rounded posteriorly. Fins large, separate, laterally attached, on the middle of the sides of the body. Siphon with small internal valve; no dorsal bridles. A large brachial cavity, extending back beneath the eye, into which the tentacular arms can be more or less retracted. Pen little developed, lanceolate, not reaching the end of the mantle. Integument beneath the eye thickened so as to be used as a false eye-lid, in addition to the transparent skin over the eye. A lachrymal pore in front of each eye; a brachial pore between the third and fourth pairs of arms. Eggs large, few, not enclosed in capsules. Accessory nidamental glands well developed. Branchial chamber divided into two cavities by a median partition or septum, which extends forward to the base of the siphon. This family is, in many respects, closely related to *Loliginidæ*, but differs widely from the latter in its visceral anatomy.

SEPIOLA Leach.

Sepiola Leach, Zool. Miscel., iii. p. 137, 1817 (t. Gray).
D'Orbigny, Céph. Acétab., p. 224.
Gray, Catal. Moll. Brit. Mus., i, p. 91, 1849.

Body short, stout, rounded posteriorly. Fins large, narrowed at base. Mantle united directly to the head by a large, dorsal commissure; lateral connective cartilages of the mantle elongated, fitting into elongated margined pits on the base of the siphon. Siphon with an internal valve. A brachial aquiferous pore between the bases of the third and fourth pairs of arms, on each side. A lachrymal pore in front of each eye. Buccal membrane with seven lobes, without suckers. Tentacular arms more or less retractile into large cavities below the eyes; club with numerous, very small, nearly equal, long-pedicelled suckers, in eight or more rows; rims not toothed. The males differ from the females in having some of the middle suckers of the lateral arms much enlarged.

Sepiola leucoptera Verrill. (Butterfly Squid.)

Verrill, Amer. Journ. Sci., vol. xvi, p. 378, 1878.
Tryon, Man. Conch., i, p. 158, 1879. (Description copied from preceding).
Verrill, Amer. Journ. Sci., xix, p. 291, pl. 15, figs 4 and 5, April, 1880.

PLATE XXXI, FIGURES 4, 5. PLATE LIV, FIGURE 4.

Species rather small; the largest specimens observed are probably

full-grown. Body short, thick, swollen, with the mantle smooth. Ventral surface, in the middle, with a large, somewhat flattened, brown, heart-shaped or shield-shaped area, bordered with blue, and surrounded, except in front, by a silvery white band, having a pearly or opalescent luster. Eyes large, with roundish pupils. Fins large, thin, broadly rounded, in the living specimens nearly as long as the body; the posterior lobe reaches nearly to the end of the body; the anterior edge extends beyond the front of the mantle to the eye. The anterior edge of the mantle is emarginate beneath; it recedes laterally to a great extent; above, it is broadly attached to the head. Sessile arms, largely webbed, short; upper ones shortest; third pair longest; suckers in two rows. Tentacular arms slender, tapering, extending back to the end of the body; club not wider than the arm, with very minute suckers, in many rows.

Upper surface of the body opalescent in some lights, thickly spotted with orange-brown, spots most numerous in the middle line and extending to the upper surface of the head; some also occur on the outer surfaces of the arms; anterior part of the head white; fins, arms and extremity of body translucent bluish white; upper surface of the eyes opalescent, with silvery blue and red tints; head, below the eyes, silvery white; above the eyes, blue.

The largest specimen, (♂) taken in 1879, (Pl. XXXI, fig. 5), when living had the head, above, in front of the eyes, whitish, with a few chromatophores; back and the base of the fins thickly spotted with brown; posterior part of the back with an emerald-green iridescence. Sides of the body, below the fins, and posterior end of the body, silvery white. A large shield-shaped ventral area of brown, with a bright blue iridescence, and bordered with a band of brilliant blue, occupies most of the lower surface. Fins, transparent whitish, except at base. Lower side of head, siphon and outer bases of the arms, light brown. Eyes blue above, green below. The fins are large, nearly as long as the body.

Length of the original type-specimen (♀), to the base of the arms, 14^{mm}, in alcohol; of mantle, above, 8^{mm}; breadth, 7^{mm}; breadth across fins, 16^{mm}. The largest specimen, of 1879, is 31^{mm} (1·25 inch) long from end of body to base of arms; breadth of body, 25^{mm} (1 inch); length of arms, 19^{mm} (·75 inch).

The male (fig. 5) of this species differs from the female in having a group of three or four decidedly and abruptly larger suckers on the middle of the third pair of arms, (Pl. LIV, fig. 4); the other suckers, along the middle portion of these arms, are also larger than on the other arms.

This species is an exceedingly beautiful one, when living, owing to the elegance and brilliancy of its colors and the gracefulness of its movements. In swimming it moves its fins in a manner analogous to the motion of the wings of a butterfly. This fact, and its bright colors, suggested the English name that I have applied to it.

Three specimens, two very young, were taken by the writer and party, of the U. S. Fish Com., in the trawl-net, 30 miles east from Cape Ann, Mass., in 110 fathoms, August, 1878. One larger male was taken by us off Cape Cod in 122 fathoms, with the bottom temperature 41° F., August, 1879. The largest specimen seen was a male, taken in the same region, Sept. 10, 1879, in 94 fathoms. It was associated with *Octopus Bairdii* and *Rossia sublevis.*

Station.	Locality.	Fath.	When Collected.	Received from	Specimens. No.	Sex.
194	Gulf of Maine	110	Aug. 31, 1878	U. S. F. Com.	3 j.	
303	Off Cape Cod	122	Aug. 21, 1879	U. S. F. Com.	1	♂
342	Off Cape Cod	94	Sept. 10, 1879	U. S. F. Com.	1*l.*	♂

ROSSIA Owen.

Rossia Owen, Trans. Zool. Soc. London, 1828 (t. Gray); Owen, in J. Ross, Second Arctic Voyage, Appendix, p. xcii, pl. 100, 1835.

D'Orbigny, Céphal. Acétab., p. 242.

Gray, Catal. Moll. Brit. Mus., i, p. 88, 1849.

Mantle-edge free from the head dorsally, adhering by a longitudinal, ovate or horse-shoe-shaped connective cartilage, having a median and two lateral grooves, fitting into corresponding grooves on the cartilage of the mantle; two lateral, oblong, ridge-like cartilages, one on each side, also fit into ovate cartilage-pits on the base of the siphon. No olfactory crests. Pupils oblong or crescent-shaped, longitudinal. A false eye-lid below the eye. A pore in front of each eye, and one, on each side, between the bases of the third and fourth pairs of arms. Tentacular arms more or less retractile into large cavities at their bases, extending back beneath the eyes; club well developed, with numerous, nearly equal suckers, forming eight or more rows; rims not toothed; borders scaled. Buccal membrane with only six lobes, without suckers. The males differ from the females in having larger suckers on the middle of the lateral arms.

Rossia megaptera, sp. nov.

PLATE XXXVIII, FIGURE 1. PLATE XLVI, FIGURE 6.

Body short, broad, depressed, covered with a soft, flabby integument,

which forms a loose border posteriorly; the front edge of the mantle extends forward dorsally into a prominent angle, but recedes very much ventrally. Fins very large and broad; their anterior insertions being but little back of the antero-lateral edge of the mantle, and their posterior insertions close to the end of the body; the free borders of the fins are thin and undulated, extending forward anteriorly beyond the edge of the mantle, while the length, from base to outer edge, is about equal to the breadth of the back between the bases of the fins.

Head very large and broad, the width exceeding that of the body. Eyes very large and prominent; lower eyelids well developed, but not much thickened. Tentacles remarkably long and slender, in extension about twice as long as the head and body together. The tentacular club is somewhat thicker than the rest of the arm, rather long, narrow-lanceolate, tapering to the tip, and covered with numerous minute, globular suckers, arranged in many rows (Pl. XLVI, fig. 6, *b–d*). Sessile arms of moderate length, rounded, very slender at tip; the 1st, 2d and 3d pairs are successively longer, while the 4th or ventral pair is about equal to the first. Suckers, (Pl. XLVI, fig. 6, *a*), rather small, arranged in two rows on all the arms. On all the arms the suckers are similar but are a little larger on the 3d pair. They are nearly globular, with a rather wide aperture, which is surrounded by a border covered with numerous small scales, arranged in many rows; the scales of the marginal series are larger and project as fine denticles around the aperture. Color purplish brown, with rather large chocolate-brown chromatophores; outer portion of fins pale, thin and translucent; edges of mantle, siphon, under side of head and arms, and greater part of tentacular arms whitish, with only minute chromatophores.

Measurements of Rossia megaptera.

	Inches.	Millimeters.
Length, end of body to dorsal edge of mantle, exclusive of membrane,	1·25	32
Length, end of body to ventral edge of mantle,	·95	24
Length, end of body to base of dorsal arms,	2·25	57
Length, end of body to tip of dorsal arms,	3·40	86
Length, end of body to tip of 2d pair,	3 75	95
Length, end of body to tip of 3d pair,	4·08	103
Length, end of body to tip of 4th pair,	3·75	95
Length, end of body to tentacular arms,	7·45	188
Breadth of body and fins together,	2·50	63
Breadth of body between bases of fins,	·85	22
Breadth of body beneath fins, exclusive of membrane,	1·10	28

Measurements of Rossia megaptera. (*Continued.*)

	Inches.	Millimeters.
Breadth of head, across eyes,	1·40	36
Breadth of fins, antero-posteriorly,	1·08	27
Length of fins, base to outer edge,	·85	22
Diameter of eyes,	·75	19
Diameter of larger suckers of lateral arms,	·06	1·5
Diameter of larger suckers of club,	·01	·25
Breadth of club,	·16	4
Length of club,	·95	24

Off the southern coast of Newfoundland, in 150 fathoms, Capt. K. Markuson and crew, schooner "Notice," June, 1880.

This species is remarkable for the great size of the fins and eyes, and for the length of the tentacular arms. It appears to be a species specially adapted for inhabiting greater depths than the species hitherto discovered. It has the same soft, flabby integument observed in *Octopus lentus* and *Stauroteuthis syrtensis*, found at similar depths. But the looseness of the skin may be due in part to the condition of the specimens when preserved. The suckers on the tentacular arms are remarkably small.

Rossia Hyatti Verrill.

Verrill, Amer. Journ. Sci., vol. xvi, p. 208, 1878.
Tryon, Man. Conch., i. p. 160, 1879. (Description compiled from preceding).
Verrill, Amer. Journ. Sci., xix, p. 291, pl. 15, figs. 1 and 2, April, 1880.

PLATE XXVII, FIGS. 8, 9. PLATE XXX, FIG. 1. PLATE XXXI, FIGS. 1, 2. PLATE XLVI, FIG. 5.

Body subcylindrical, usually broader posteriorly; in preserved specimens, variable in form according to contraction. Dorsal surface covered with small, conical, scattered, whitish papillæ, which are also found on the upper and lateral surfaces of the head and bases of the arms; those around the eyes largest; one on the mantle, in the median line, near the front edge, is often elongated. Front border of mantle sinuous, slightly advancing in the middle, above. Fins moderately large, nearly semicircular, attached from the posterior end for about four-fifths the whole length, the front end having a small, rounded free lobe. The distance from the posterior junction of the fins to end of body is less than that from the anterior junction to edge of mantle, the center of the fin being at about the middle of the body. Siphon elongated, conical, with a small opening. Head depressed, more than half the length of the body. Eyes large, the lower eyelid prominent, but not much thickened. Sessile arms short, united at

their bases by a short web, which is absent between the ventral arms; the dorsals are shortest; the third pair the longest and largest; the second pair and ventrals about equal in length. Suckers, (Pl. XLVI, fig. 5, *a*), numerous, sub-globular, not very small, the margin bordered with several rows of minute scales; near the base of the arms they are biserial, there being usually four to six thus arranged in each row; then, along the rest of the length of the arms they become more crowded and form about four rows, those in the two middle rows alternating with those in the marginal rows; toward the tip they become very small and crowded, especially on the dorsal and ventral arms. The number of suckers varies with age, but on one of the larger specimens they were as follows: on each dorsal arm, sixty; on one of second pair, fifty-five; of third pair, fifty-three; of ventral, sixty-five. In this specimen (♀), the third arm of the right side and ventral arm of left side were abruptly terminated (accidentally), while the others were tapered to acute points. The tentacular arms, in preserved specimens, will extend back to the posterior end of the body; the naked portion is smooth, somewhat triquetral, with the outer side convex and the angles rounded; terminal portion widening rather abruptly, long ovate-lanceolate, curved and gradually tapered to the tip; the sucker-bearing portion is bordered by a wide membrane on the upper and a narrow one on the lower margin; the suckers (Plate XLVI, fig. 5, *b*, *c*,), are very small, sub-globular, crowded in about eight to ten rows in the widest portion.

The males differ from the females in the relatively greater size of the suckers on the middle of the lateral and ventral arms, those toward the tips becoming somewhat abruptly smaller, while in the female they decrease more gradually.

Color, pinkish, thickly spotted with purplish brown above, paler and more sparsely spotted beneath and on the outside of the long arms; the inner surface of the arms and front edge of the mantle are pale.

Length from bases of arms to posterior end of body, 40^{mm}; of body, 25; of head, 15; breadth of body, 17; of head 17; length of fins, 15; of insertion, 11; breadth of fin, 8; front of fin to edge of mantle, 5; length of free portion of dorsal arms, 12·5; of second pair, 15; of third pair, 18; of ventrals, 13; of tentacular arms, 40; breadth of dorsal arms, at base, 3·5; of second pair, 3·5; of third pair, 4; of ventrals, 3·5; of tentacular arms, at base, 2; at expanded portion, 3·5; length of latter, 10·5; diameter of largest suckers of sessile arms, 0·9; length of free portion of siphon, 7^{mm}.

One of the largest alcoholic specimens (♀), from station 218, has the mantle 31^{mm} long, dorsally; greatest breadth beneath the fins, 20^{mm}; length of fins longitudinally, 18^{mm}; transverse breadth of fins, 11^{mm}; length from end of body to tip of dorsal arms, 57^{mm}; to tip of second pair of arms, 59^{mm}; of third pair, 64^{mm}; of fourth pair, 59^{mm}.

Rossia Hyatti.—Specimens examined.

No.	Locality.	Fath.	Bottom.	When coll'd.	Rec'd from	Specimens. No. Sex.
				1877	U.S.F.C.	
30, 31	Off Salem, Mass.	48	mud	Aug. 13	"	2 j.
33	Off Cape Ann, 13 m.	90	mud	Aug. 14	"	1 l. ♂
42–46	Off Cape Sable, N. S., 30 m.	88–90	sand and mud	Aug. 21	"	1 ♂:1 ♀:3j.
48	Off Cape Sable, N. S., 20 m.	59	rocky	Aug. 21	"	1 j. ♀
85–86	Off Halifax, N. S., 26 m.	101	fine sand	Sept. 6	"	2 l. ♀
	Gulf of Maine and Massachusetts Bay.			1878		
130	Off Cape Ann, 14 m.	49	mud	July 23	"	3 j.
156	Off Gloucester, Mass., 8 m.	42	sand and mud	Aug. 15	"	2 j.
163	Off Cape Ann, 6½ m.	73	fine sand	Aug. 16	"	1 ♂:2 j. ♀
164	Off Cape Ann, 7 m.	75	fine sand	Aug. 16	"	1 ♀
181	Off Gloucester, Mass.	45	mud	Aug. 29	"	4 ♀
184	Off Gloucester, Mass., 5 m.	45	mud	Aug. 29	"	1 j.
211	Off Cape Ann, 6 m.	60	soft dark-br. mud	Sept. 17	"	1 j. ♂:1j. ♀
214	Off Cape Ann, 7 m.	57	fine mud and sand	Sept. 17	"	1 ♀
217	Off Cape Ann, 6 m.	45	soft dark-br. mud	Sept. 18	"	1 l. ♂
218	Off Cape Ann, 6 m.	45	soft dark-br. mud	Sept. 18	"	1 l. ♀:1 j.
223	South of Cape Ann, 7 m.	47	soft brown mud	Sept. 21	"	1 ♂
234	Off Gloucester, Mass., 5½ m.	43	soft brown mud	Sept. 24	"	1 ♀
238	Off Gloucester, Mass., 4½ m.	43	soft brown mud	Sept. 26	"	2 j.
				1879		
264	Off Cape Cod, 15 m.	80	blue mud	July 29	"	1 l. ♂
276	Off Cape Cod, 6½ m.	47	blue mud	Aug. 1	"	1 l. ♀
324	Off Cape Cod, 11 m.	45	sand	Sept. 1	"	1 l. ♂
364	Off Cape Cod, 15 m.	70	sand	Sept. 18	"	1 l. ♀:3j. ♀
372	Off Chatham, Mass., 21 m.	70	sand	Sept. 19	"	1 ♂
						1 l. ♀
	Gloucester Fisheries.			1878.		
241	N. Lat. 44° 20′ W. Long. 59°	60	----------	Dec.	"	1 j.
372	Off Miquelon I.	7	----------	July.'79	"	1 j.
39 Gl.	Off Gloucester, in Cod.	--	----------	------	"	1 l. ♀

This species has been taken in numerous localities, by the dredging parties of the U. S. Fish Commission, in 1877, 1878 and 1879, off Cape Cod; in Mass. Bay, 40–50 fathoms; off Cape Ann, in the Gulf of Maine, 50–100 fathoms; off Cape Sable, N. S., 88–92 fathoms; off Halifax, N. S., 57–100 fathoms, on a fine compact sand and mud bottom. It occurs in from 40 to 100 fathoms. It has also been received through the Gloucester halibut fishermen, from the Banks, off Nova Scotia. One specimen (lot 241), presented by Capt. Chris. Olsen, and crew, of the schooner "William Thompson" was from N. Lat. 44° 20′;

W. Long. 59°, in 60 fathoms; another from 7 fathoms, off Miquelon I., (lot 372), was presented by Capt. C. D. Murphey and crew, of the schooner "Alice M. Williams." Its relatively large eggs (Pl. XXVII, fig. 9) are laid in August and September, in small clusters, slightly attached together, in the large oscules or cavities of several species of sponges.

It is frequently associated with *Octopus Bairdii* V., and the following species.

This species has a strong general resemblance to *R. glaucopis* Lovén, as figured in the admirable work of G. O. Sars but the latter has shorter lateral arms, and the suckers of the sessile arms are in two rows, while they are four-rowed in our species.

Rossia sublevis Verrill.

Rossia sublevis Verrill, Amer. Jour. Sci., vol. xvi, p. 209, 1878.

Tryon, Man. Conch., i, p. 160, 1879. (Description compiled from preceding.)

Verrill, Amer. Journ. Sci., xix, p. 291, pl. 15, fig. 3, Apr., 1880; Bulletin Mus. Comp. Zool., viii, p. 104, pl. 3, figs. 2–4; pl. 7, fig. 4, 1881.

PLATE XXX, FIGURE 2, ♀. PLATE XXXI, FIGURE 3, ♀. PLATE XLVI, FIGURE 4. PLATE XLVII, FIGURES 2–3, ♀, FIGURE 4, ♂.

Larger and relatively stouter than *Rossia Hyatti*, with the fins larger and placed farther forward, the rounded front edge of the large free lobe reaching nearly to the edge of the mantle. Head large and broad. Eyes very large.

Sessile arms more slender and less unequal in size than in the preceding species, and with the suckers arranged in two regular rows throughout the whole length. Anterior edge of the mantle scarcely sinuous, advancing but little dorsally. Upper surface of the body and head nearly smooth, but in the larger specimens, especially the males, usually with a few very small whitish papillæ, most numerous near the front edge of the mantle. Color, nearly as in the preceding species.

The pen (Plate XLVI, figure 4) is small and thin, much shorter than the mantle. The shaft is narrow; the blade is rather abruptly wider and rather shorter than the shaft; its posterior portion is very thin, with the edge ill-defined.

The males, when adult, can be easily distinguished from the females, by the larger size of the suckers along the middle of the two lateral pairs of arms (Plate XLVII, figure 4), and, to a less extent, of the ventral pair. These large suckers are oblong, with a groove or constriction around the middle, the part below the groove larger

than that above it; the aperture is small, ovate, with a smooth rim; their pedicels are short and laterally attached. In the female the corresponding suckers are not only smaller but are differently shaped, the basal portion being smaller than the upper portion. The suckers of the tentacular arms are very numerous, minute, shallow, cup-shaped, with oblique rims and slender pedicels; they are nearly equal and appear to form eight to twelve rows.

Young specimens, with the mantle less than 12^{mm} in length, can scarcely be distinguished sexually by external characters, and are not easily distinguished from the young of *Rossia Hyatti*, of similar size.

One of the original specimens (♀) measured, from the base of the arms to the end of the body, 46^{mm}; length of body, 31; of head, 15; breadth of body, 22; of head, 23; length of fins, 20; of their insertion, 16; breadth of fins, 10; front edge of fin to edge of mantle, 2·5; length of free portion of dorsal arms, 16; of second pair, 17; of third pair, 20; of ventrals, 15; of tentacular arms, 25; breadth of dorsal arms at base, 3; of second pair, 3; of third, 3·5; of ventrals, 3·5; of tentacular arms, 3·5; of the terminal portion, 3·75; its length, 10; diameter of the largest suckers of sessile arms, ·8; length of free portion of siphon, 7^{mm}.

Measurements of Rossia sublevis and R. Hyatti, in millimeters.

	R. sublevis.		R. Hyatti.	
Sex	♂	♀	♂	♀
Station	879	894	324	218
Length of mantle, above	29	32	21	31
Breadth of mantle	22	25	17	19
Breadth across head	26	30	15	20
Diameter of eyes	16	16	8	9
Length of a fin	21	24	11·5	17
Length of its base	17	19	10	12
Transverse breadth of a fin	14	15	7	10·5
Length to base of dorsal arms*	45	47	31	45
" " " third pair	46	47	32	43
" " " ventral arms	41	43	26	39
" tip " dorsal arms	64	71	42	58
" " " second pair	65	75	43	59
" " " third pair	66	78	46	64
" " " ventral pair	61	74	42	60
Length of tentacular club	9	15	7	10
Its breadth	2·5	3	2	2·5
Diameter of largest suckers of lateral arms	2·2	1.1	1·5	.8

* The length to the 'bases' of the arms, is from the posterior end of the body to the free edge of the basal web, between the arms; that of the third pair is to the edge of the web, between the second and third pairs. The measurements are all from well preserved alcoholic specimens.

One of the specimens (No. 16), taken by Mr. Agassiz, in 357 fathoms, is a young female differing somewhat from the others in having the arms shorter, with the suckers more crowded, so that they apparently form more than two rows. Possibly this should be referred to *R. Hyatti* Verrill. Its back is smooth. All three specimens from this same region differ somewhat from those taken farther north, in shallower water, in having larger eyes and shorter and stouter arms.

Rossia sublevis.—Specimens examined.

Stat.	Locality.	Fath.	Bottom.	When coll'd.	Rec'd from	Specimens. No. Sex.
				1877	U.S.F.C.	
84	Off Halifax, N. S., 26 miles	101	fine sand	Sept. 6	"	1 l. ♀ : 1 j.
85, 86	Off Halifax, N. S., 26 miles	101	fine sand	Sept. 6	"	1 ♂ : 1 j. ♀
100	Off Halifax, N. S.	42	fine sand	Sept. 15	"	eggs & juv.
				1878		
161	Off Cape Ann, 6 miles	54	----------	Aug. 6	"	1 l. ♂
194	Off Cape Ann, 33 miles	110	muddy	Aug. 31	"	
				1879		
264	Off Cape Cod, 15 miles	80	blue mud	July 29	"	1 ♂ : 1 l. ♀ : 3 j.
324	Off Cape Cod, 11 miles	45	sand	Sept. 1	"	1 l. ♂
364	Off Cape Cod, 15 miles	70	sand	Sept. 18	"	1 j.
	Off Newport, R. I.					
	N. lat. W. long.			1880		
869	40° 02′ 18″; 70° 23′ 06″	192	fine sand and mud	Sept. 4	"	1 ♂ : 5 ♀
870	40 02 36 ; 70 22 58	155	fine sand and mud	Sept. 4	"	1 ♂ : 1 ♀
880	39 48 30 ; 70 54 00	252	fine sand and mud	Sept. 13	"	1 l. ♂
893	39 52 20 ; 70 58 00	372	mud, fine sand	Oct. 2	"	1 j.
894	39 53 00 ; 70 58 30	365	mud, fine sand	Oct. 2	"	1 l. ♂ : 1 j. ♀
895	39 56 30 ; 70 59 45	238	mud, fine sand	Oct. 2	"	1 l. ♂ : 1 l. ♀ : 5
897	Off Chesapeake Bay	157	----------	Nov. 16	"	1 l. ♂ [eggs
	Blake Exped. U. S. Coast Survey.					
310	39° 59′ 16″; 70° 18′ 30″	260	----------	1880	A. Agas.	1 ♀ ad.
320	32 33 15 ; 77 30 10	257	----------	1880	"	1 ♀ ad.
321	32 43 25 ; 77 20 30	233	----------	1880	"	1 ♀ j. ?
	Gloucester Fisheries.					
265	42° 49′ ; 62° 57′	250	----------	Jan.'79	U.S.F.C.	1 j.

This has been taken, by the dredging parties of the U. S. Fish Commission, in the trawl-net, at various localities, in 1877, 1878, and 1879, in 45 to 110 fathoms, off Massachusetts Bay, off Cape Cod, and off Halifax, N. S. It has been brought in by Capt. J. W. Collins and crew, of the schooner "Marion," (lot 265) from the banks off Nova Scotia. It was trawled in some numbers, and of both

sexes, by the U. S. Fish Commission, in 1880, off Newport, R. I., in 155 to 372 fathoms; and in November, 1880, by Lieut. Z. L. Tanner, on the "Fish Hawk," off the mouth of Chesapeake Bay, in 157 fathoms. It was taken by Mr. Agassiz, on the "Blake," in 233–260 fathoms, and as far south as lat. 32° 33′ 15″.

This species very closely resembles the *Rossia glaucopis* Lovén, of Northern Europe, as figured by G. O. Sars. The latter is, however, more papillose, and has smaller eyes and head, if correctly figured.

HETEROTEUTHIS Gray.

Heteroteuthis (sub-genus) Gray, Catal. Moll. Brit. Mus., i, p. 90, 1849.

The body is short, thick, rounded posteriorly. Fins large, with narrower bases, attached near the middle of the sides of the mantle. Head and eyes large. Anterior border of the mantle-edge free, dorsally. Connective cartilages on the base of the siphon, with an ovate pit; lateral cartilages of mantle, simple, longitudinal ridges. Pen much shorter than the mantle, narrow anteriorly; posterior blade small, slightly expanded laterally. Club of the tentacular arms well developed, with numerous suckers, in about eight rows, those in the lower marginal rows decidedly larger than the rest; rims of the suckers with smooth edges; the membranous edge of the aperture is denticulated by small, acute scales. Middle suckers of the lateral and ventral arms distinctly larger in the female; in the male abruptly very much larger than on the others; these suckers are deep, with a small, round, smooth rim, and with a raised zone around the middle. In the male the left dorsal arm is hectocotylized by having much smaller and more numerous suckers, arranged in four rows, and by the development of the marginal membrane.

Heteroteuthis tenera Verrill.

Amer. Jour. Sci., xx, p. 392, November, 1880; Proc. Nat. Mus., iii, p. 360, 1880; Bull. Mus. Comp. Zool., viii, p. 103, pl. 3, figs. 5–5*b*, pl. 8, figs. 2–2*d*, 3–3*b*, 1881.

PLATE XLVI, FIGURES 2–2*d*, 3–3*b*. PLATE XLVII, FIGURES 5–5*b*.

A small and delicate species, very soft, translucent, and delicately colored when living.

Body short, cylindrical, scarcely twice as long as broad, posteriorly; usually round, but in strongly contracted, preserved specimens, often narrowed and even obtusely pointed; front edge of mantle sometimes with a slight dorsal angle, in most cases emarginate. Fins very large, thin, longer than broad, the outer edge broadly rounded, the